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A Quality Improvement Project to Assist with the Implementation of an Evidence-Based Adult Sepsis Guideline

Austin Williams

A QUALITY IMPROVEMENT PROJECT TO ASSIST WITH THE IMPLEMENTATION OF AN EVIDENCED-BASED ADULT SEPSIS GUIDELINE

by

Austin L. Williams

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Approved by:

Dr. Michong Rayborn, Committee Chair
Dr. Nina McLain, Committee Member

Dr. Michong Rayborn Committee Chair	Dr. Lachel Story Director of School	Dr. Karen S. Coats Dean of the Graduate School

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ABSTRACT

Through a systematic review of data, a clinical affiliate hospital in south Mississippi identified opportunities to improve their treatment of adult patients presenting with or developing sepsis. In response, the facility initiated an ongoing quality improvement program to revise their management of patients meeting sepsis and septic shock criteria, which included elements of the 2012 Surviving Sepsis Campaign (SSC) guidelines. The purpose of this Doctor of Nursing Practice (DNP) project was to determine the current best practice recommendations for early adult sepsis management to assist with the implementation of an evidence-based adult sepsis guideline.

The reviewed literature reported that the current best practice recommendations for early management of adult patients with sepsis include: (a) measurement of a serum lactate level within one hour of sepsis recognition and revaluation if the initial lactate level is ≥ 2 millimoles per liter (mmol/L); (b) obtaining blood cultures prior to the administration of antibiotic therapy; (c) administration of broad-spectrum antibiotics within one hour sepsis recognition; (e) rapid administration of 30 milliliters per kilogram (mL/kg) of intravenous (IV) crystalloid within one hour of sepsis recognition associated with hypotension or serum lactate ≥ 4 mmol/L; and (f) administration of vasopressors for hypotension during or after the initial fluid resuscitation to maintain a mean arterial pressure (MAP) ≥ 65 mmHg (Lester, Hartjes, & Bennett, 2018; Levy, Evans, & Rhodes, 2018; Rhodes et al., 2017). The best practice recommendations were presented to a panel of experts including (a) two Acute Care Nurse Practitioners (ACNPs), (b) two Emergency Department (ED) physicians, and (d) two Certified Registered Nurse Anesthetists (CRNA) at the facility where this project was conducted. Sixty-six percent

of the panel of experts strongly agreed that the information provided was beneficial and relevant to their institution. Additionally, 66% of the panel was provided with new information for the management of adult patients with sepsis based on the best practice recommendation presented. Each member of the panel of experts agreed the best practice recommendations should be adopted.

ACKNOWLEDGMENTS

I would like to offer thanks to my chair, Dr. Michong Rayborn, for her patience and guidance throughout this process. I would also like to thank Dr. Nina McLain for her support that made this project possible.

DEDICATION

First, I would like to thank God for blessing me with the ability to accomplish this achievement. I would like to dedicate the completion of this project to my wonderful wife, Ashton, and my son, Braiden. To my family and friends, thank you for your love and support throughout this process.

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LIST OF ABBREVIATIONS

ACNP	Acute Care Nurse Practitioner
CDC	Centers for Disease Control and Prevention
CRNA	Certified Registered Nurse Anesthetist
DNP	Doctor of Nursing Practice
ED	Emergency Department
ICU	Intensive Care Unit
MAP	Mean Arterial Pressure
mmHg	Millimeters of Mercury
mmol/L	Millimoles per Liter
mm3	Cubic Millimeter
MDH	Mississippi State Department of Health
qSOFA	Quick Sequential Organ Failure Assessment
ScvO2	Central Venous Oxygen Saturation
SIRS	Systemic Inflammatory Response Syndrome
SSC	Surviving Sepsis Campaign
USM	The University of Southern Mississippi
WBC	White Blood Cell

CHAPTER I – INTRODUCTION

Sepsis, a syndrome of life-threatening organ dysfunction induced by a dysregulated host response to infection, is a leading cause of critical illness and death in the United States (Paoli, Reynolds, Sinha, Gitlin, & Crouser, 2018; Singer et al., 2016). According to the Centers for Disease Control and Prevention (CDC, 2018), more than 1.5 million Americans are diagnosed with sepsis each year; resulting in over 250,000 deaths. Currently, sepsis leads to 20% of all intensive care unit (ICU) admissions and is the most common cause of death in non-cardiac ICUs (Makic & Bridges, 2018). In Mississippi, septicemia is the 10th leading cause of death according to the Mississippi State Department of Health (MDH, 2018), resulting in 636 fatal cases in 2016 (CDC, 2017). That same year, Mississippi had the second-highest national sepsis mortality rate of 19%, compared with an overall U.S. mortality rate of 10.7% (CDC, 2017).

Despite advances in clinical practice, the incidence of sepsis continues to increase, as well as associated healthcare costs (Paoli et al., 2018). According to Paoli et al. (2018), the healthcare cost of sepsis in 2013 was $24 billion, accounting for 13% of the total U.S. hospital cost but causing only 3.6% of hospital admissions. In response to the increasing incidence of sepsis, in 2002, a collaboration between the Society of Critical Care Medicine and the European Society of Intensive Care Medicine known as the SSC was founded. This campaign was founded to reduce mortality of sepsis and septic shock worldwide through (a) building awareness of sepsis, (b) improving diagnosis, (c) increasing the use of appropriate treatment, (d) educating healthcare professionals, (e) improving post-ICU care, (f) developing guidelines for care, and (g) implementing performance improvement programs (White, 2016). Recently, this

organization has published updated guidelines for sepsis management in their *International Guidelines for Management of Sepsis and Septic Shock: 2016*, with an update published in 2018. Prior versions of this guideline were published in 2004, 2008, and 2012 (Dellinger, Schorr, & Levy, 2017). These guidelines recommend early recognition and initiation of evidence-based interventions, which include measurement of serum lactate levels, rapid administration of antibiotics, prompt fluid resuscitation in the presence of hypoperfusion, and vasopressor administration if indicated (Howell & Davis, 2017; Makic & Bridges, 2018; Rhodes et al., 2017).

Problem Description

Through a systematic review of data, a clinical affiliate hospital located in south Mississippi identified opportunities to improve their treatment of patients presenting with or developing sepsis. This facility is the main hospital for a collaborative network of medical institutions that provides regional health services across 19 surrounding counties. According to the MDH (2018), 136 reported deaths were caused by septicemia within this region in 2017, 99% of which occurred in adults 25 years and older, and 73% in those 65 years and older. Additionally, the local county of the facility experienced the second-highest occurrence of sepsis mortality within the region, which included 20 reported fatalities that year (MDH, 2018). In response to this, the facility established an ongoing sepsis quality improvement program to revise their approach to the identification and treatment of patients meeting sepsis and septic shock criteria, which currently incorporates elements of the 2012 SSC guidelines. Therefore, the purpose of this doctoral project was to determine the current best practice recommendations for early

adult sepsis management to assist an existing quality improvement program with the implementation of an evidence-based adult sepsis guideline.

Available Knowledge

During the initial phase of this project, a literature review was conducted utilizing online databases that included CINAHL, Cochrane Library, Elsevier Science Direct, EBSCO-host, Google Scholar, and PubMed. Keywords and combinations of words used for the search included adult, sepsis, severe sepsis, septic shock, systemic inflammatory response syndrome, septicemia, surviving sepsis campaign, treatment, management, sepsis guidelines, sepsis bundles, and sepsis identification tools. The initial search generated 156 articles from 2010 to 2019. Study designs such as cohort studies, randomized control trials, prospective and/or retrospective studies, meta-analyses, and systematic reviews of adult patients (≥ 18 years old), published in the English language were required for inclusion. Several of these studies were reviewed, and 17 met the inclusion criteria. Exclusion criteria included irrelevant studies and insufficient data. Unless a study was significant to this project, the search was limited to literature published within the last five years.

Sepsis Defined

Since the initial definition was developed in 1991, the defining characteristics of sepsis have remained primarily unchanged (Singer et al., 2016). In 2014, the Society of Critical Care Medicine and the European Society of Intensive Care Medicine reexamined the definition of sepsis. A joint task force was created to review and update the clinical understanding of sepsis-induced changes in pathobiology. The revised definition of sepsis differentiates from an uncomplicated infection, as sepsis is not a specific illness,

but rather a syndrome still not completely understood (Singer et al., 2016). The revised terms and clinical criteria are published in the *Third International Consensus Definitions for Sepsis and Septic Shock,* also known as the Sepsis-3 Consensus. The existing definitions are included in the Sepsis-2 Consensus that was published in 2001.

Table 1

Sepsis-2 Terminology

Terminology	Sepsis-2 Definitions and Criteria
SIRS	Systemic inflammatory response to a variety of clinical insults that is manifested as two or more of listed criteria. SIRS criteria include: (a) temperature > 38 or <36 °C; (b) heart rate > 90 beats/min; (c) respiratory rate >20 breaths/min; (d) white blood cell count >12,000/mm3 or <4,000/ mm3 or >10% immature bands.
Sepsis	Sepsis is an infection or suspected infection leading to the onset of SIRS.
Severe Sepsis	Sepsis complicated by organ dysfunction.
Septic Shock	Sepsis-induced hypotension persisting despite adequate fluid resuscitation

Note. mmHg = millimeters of mercury. mmol/L = millimoles per liter. mm3 = cubic millimeter. Adapted from "Assessment of Clinical Criteria for Sepsis: For the Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3)" by C. W. Seymour, V.X. Liu, T. J. Iwashyna, F. M. Brunkhorst, T. D. Rea, A. Scherag, … D. C. Angus, 2016, Journal of the American Medical Association, 315, p. 762-774.

Table 2

Sepsis-3 Terminology

Terminology	Sepsis-3 Definitions and Criteria
SIRS	Not incorporated into Sepsis-3 definitions.
Sepsis	Sepsis is life-threatening organ dysfunction due to a dysregulated host response to infection.

Table 2 (continued).

Severe Sepsis	Not incorporated into Sepsis-3 definitions.
Septic Shock	Septic Shock is sepsis in which particularly profound circulatory, cellular, and metabolic abnormalities substantially increase mortality. Criteria includes the requirement of vasopressor therapy to maintain a MAP ≥ to 65 mmHg and an elevated lactate level greater that 2 mmol/L after completion of adequate fluid resuscitation.

Note. MAP = mean arterial pressure. mmHg = millimeters of mercury. mmol/L = millimoles per liter. mm3 = cubic millimeter. Adapted from "Assessment of Clinical Criteria for Sepsis: For the Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3)" by C. W. Seymour, V.X. Liu, T. J. Iwashyna, F. M. Brunkhorst, T. D. Rea, A. Scherag, … D. C. Angus, 2016, Journal of the American Medical Association, 315, p. 762-774.

Clinical Manifestations

The clinical manifestations of sepsis differ between patients, ranging from subtle to profound acute hemodynamic changes related to the cause of the infection, site of origin, and degree of organ dysfunction (Cecconi, Evans, Levy, & Rhodes, 2018). The clinical presentation of symptoms is due to the body's overwhelming response to the infection and the specific organ system involved (Gotts & Matthay, 2016). These clinical manifestations include: (a) confusion, (b) delirium, (c) shortness of breath, (d) tachypnea, (e) tachycardia, (f) hypotension, (g) fever, (h) generalized pain, and (I) diaphoresis (CDC, 2018; Gotts & Matthay, 2016).

A multitude of infections can lead to the development of sepsis, resulting in varying degrees of organ dysfunction. The occurrence of organ dysfunction may be subtle, making this life-threatening syndrome challenging to diagnose (Novosad et al., 2016). The organ systems most commonly affected by sepsis are the cardiovascular and respiratory systems (CDC, 2018). Severe compromise of these systems results in

circulatory failure, myocardial dysfunction, elevated serum lactate, and development of acute respiratory distress syndrome (Cecconi et al., 2018; Gotts & Matthay, 2016).

Best Practice Guidelines and Sepsis Bundles

The SSC summarizes their guidelines as bundles, which outlines the main features of the recommendations for the diagnosis and treatment of sepsis (Rhodes et al., 2017). Jozwiak, Monnet, & Teboul (2016) describe bundles as a set of interventions associated with a disease process that, when used together, result in improved outcomes compared to implementing them individually. The goals of bundles in the treatment of sepsis are to reduce mortality, improve outcomes, and ensure the application of evidence-based practices (Jozwiak, Monnet, & Teboul, 2016). Bundles based on the 2012 SSC guidelines were for severe sepsis and septic shock related diagnosis and treatment, with the first to be completed within three hours and the second is to be completed within six hours of presentation or sepsis recognition, known as time zero (Levy, Evan, & Rhodes, 2018). In 2018, the SSC updated these bundles to incorporate new evidence, which now includes one bundle to be completed within one hour of time zero (Levy et al., 2018). This sepsis management outlined by the SSC is intended for use in the emergency department (ED), general hospital floors, and the ICU (Levy et al., 2018; Makic & Bridges, 2018; Rhodes et al., 2017).

Before the 2018 update, the SCC recommended two measures for the reassessment of fluid status and tissue perfusion. The first measure included a repeat focused exam after the initial resuscitation that involves assessing vital signs; cardiopulmonary, capillary refill, pulse and skin findings. The second measure included: (a) measurement of central venous pressure (CVP), (b) measurement of central venous

oxygen saturation (ScvO2), (c) bedside cardiovascular ultrasound, and (d) assessment of fluid responsiveness with a fluid challenge (Makic & Bridges, 2018; Rhodes et al., 2017). According to the updated SSC guidelines, reassessment is now recommended to be completed thorough examination and evaluation of noninvasive variables, as well as invasive if available (Rhodes et al., 2017). Further assessment of hemodynamic variables is recommended if necessary, to determine a diagnosis (Rhodes et al., 2017).

Table 3

Three- and Six-Hour Bundles

Three Hour Bundle
1. Measure lactate level
2. Obtain blood cultures prior to administration of antibiotics
3. Administer broad-spectrum antibiotics
4. Administer 30 mL/kg of IV crystalloid for hypotension or lactate ≥ 4 mmol/L
Six Hour Bundle
5. Apply vasopressors to maintain a MAP ≥ 65 mmHg.
6. Reassessment of volume status and tissue perfusion with documentation of findings if hypotension persists after initial fluid volume replacement or the initial lactate was ≥ 4 mmol/L.
7. Re-measure of lactate if initial lactate was elevated

Note. mL/kg = milliliters per kilogram. mmol/L = millimoles per liter. mmHg = millimeters of mercury. Adapted from "Implementing Sepsis Bundles" by Jozwiak et al., 2016, Annals of Translational Medicine, 4(17), 332-340 https://doi.org/10.21037/atm.2016.08.60

Table 4

One-Hour Bundle

One Hour Bundle
1. Measure lactate level.
2. Obtain blood cultures prior to administration of antibiotics.
3. Administer broad-spectrum antibiotics.
4. Begin rapid administration of 30 mL/kg of crystalloid for hypotension or lactate ≥ t mmol/L.
5. Apply vasopressors if patient is hypotensive during or after fluid resuscitation to maintain MAP ≥ 65 mmHg.

Table 4 (continued)

6. Frequent hemodynamic reassessments of patient's fluid status through noninvasive measurements including vital sign assessment; cardiopulmonary, capillary refill, pulse, and skin findings; or bedside cardiovascular ultrasound
7. Re-measure of lactate if initial lactate was elevated

Note. mL/kg = milliliters per kilogram. Mmol/L = millimoles per liter. mmHg = millimeters of mercury. Adapted from "The Surviving Sepsis Campaign Bundle: 2018 update" by Levy, M. M., Evans, L. E., & Rhodes, A., 2018, *Intensive Care Medicine*, *44*(6), 925–928. https://doi.org/10.1007/s00134-018-5085-0

Implementation of these sepsis bundles has been associated with positive patient outcomes and reduced mortality (Jozwiak et al., 2016). A systematic review and meta-analysis of 50 observational studies published between 2006 and 2014 were conducted to determine the effects of performance improvement programs and compliance with sepsis bundles on sepsis mortality (Damiani et al., 2015). This review reported a reduction in mortality from multiple included studies that performed improvement initiatives that adhered to sepsis bundles, with an overall odds ratio of 0.66 (95% CI: 0.61-0.72) (Damiani et al., 2015). Another observational study conducted over an 11-month (N =167) period evaluated the impact of sepsis bundles on mortality. This study reported a 44% reduction in mortality of the population who received interventions outlined in sepsis bundles compared to the patients who did not, which correlated with a 4% decrease in the rates of admission to the ICU with every 10% increase in bundle compliance (Teles et al., 2017).

In a multicenter study conducted in 218 ICUs between January 2005 and June of 2012 (N =29,470), mortality was reported to be lower in locations with high sepsis bundle compliance (29.0%) compared to sites with low compliance (38.6%) (Levy et al., 2014). The conclusion of this multicenter study demonstrated a 25% relative risk

reduction in mortality rate associated with increased compliance with sepsis bundles (Levy et al., 2014). In another multisite observation study consisting of three independent cohorts (N =15,000), improved mortality rates were reported with compliance to the three-hour sepsis bundle (Leisman et al., 2017). In the first cohort, bundle compliant mortality was 22.6% compared to noncompliant of 26.5% (OR, 0.72 [CI, 0.59-0.75], p <0.001). In the second cohort, bundle compliant mortality was 13.4% compared to noncompliant of 17.8% (OR, 0.60 [CI, 0.44-0.80], p =0.001)). In the third cohort, compliant bundle mortality was 18.1% compared to noncompliant of 21% (OR, 0.84 [CI, 0.73-0.96], p =0.013) (Leisman et al., 2017).

Serum Lactate. The evaluation of serum lactate is an essential variable in the clinical management of sepsis-induced vasodilation (Makic & Bridges, 2018; Rhodes et al., 2017). Serum lactate levels do not provide a direct calculation of tissue perfusion, but rather this laboratory value assists in identifying abnormalities and tissue hypoxia associated with this disease process (Rhodes et al., 2017; Singer et al., 2016). Lactate levels that are greater than two mmol/L represent the presence of tissue hypoperfusion, and the severity of tissue hypoperfusion as this laboratory value increases (Makic & Bridges, 2018). Evaluation of this laboratory value allows for an objective measurement of fluid status to be assessed, which can assist in guiding management in comparison to other indicators alone, such as urine output and other variables of clinical examination (Rhodes et al., 2017). In a recent study conducted over five years (N =1,060) that evaluated lactate levels as a predictor of mortality, higher levels of serum lactate were recorded from subjects who did not survive (Ryoo et al., 2018). A median six-hour

lactate level of 4.6 mmol/L of nonsurvivors was reported in comparison to a level of 2.5 mmol/L in the survivor group of this study (Ryoo et al., 2018).

Source Control and Antimicrobial Therapy. Identifying the source of infection is essential to appropriately provide care to this population (Rhodes et al., 2017). Upon presentation, a quick assessment should be completed to identify and rule out likely sources of infection (Gotts & Matthay, 2016; Makic & Bridges, 2018). After locating the source, the responsible infectious pathogen should be identified through routine blood, sputum, and urine cultures (Levy et al., 2018; Rhodes et al., 2017). Obtaining these samples should be completed before starting intravenous (IV) antibiotic therapy in patients with suspected sepsis; as long as this does not delay treatment (Levy et al., 2018; Rhodes et al., 2017). The SSC recommends that IV antibiotics be initiated as soon as possible, with a goal administration within one hour of identifying sepsis or sepsis shock (Levy et al., 2018; Makic & Bridges; 2018; Rhodes et al., 2017). The rapid initiation of antibiotics has been associated with improved outcomes and reduced mortality in adult patients with sepsis (Johnston et al., 2017; Rhodes et al., 2017). A systematic review and meta-analysis consisting of 10 quantitative studies published between 1990 and 2016 was conducted to determine the effect of antimicrobial administration on sepsis patients in tertiary care. This review reported a 33% reduction in mortality odds for patients who received IV antibiotics within one hour of sepsis recognition compared to the population who experienced delayed administration (OR, 0.67 [95% CI, 0.59-0.75]) (Johnston et al., 2017). Additionally, in a retrospective cohort study completed at a 656-bed medical institution (N =3,929) to determine the effects of initial antibiotic administration with the

progression of sepsis, each hour that antimicrobial administration was delayed associated with an 8% increase in progression of septic shock (Whiles, Deis, & Simpson, 2017).

Fluid Resuscitation and Vasopressors. Early fluid resuscitation is a vital part of sepsis management which supports tissue perfusion and hemodynamic components (Levy et al., 2018; Makic & Bridges, 2018; Rhodes et al., 2017). Delays in fluid resuscitation are related to poor patient outcomes, including acute organ injury, presenting as hypotension, and elevated serum lactate (Gotts & Matthay, 2016). Initial resuscitation for induced hypoperfusion recommended by the SSC includes the administration of 30 mL/kg of IV crystalloid fluid within 1 hour of patient presentation or sepsis recognition that is associated with hypotension or serum lactate ≥ 4 mmol/L (Levy et al.,2018; Rhodes et al., 2017). In an observational cohort study that was conducted over a 13-month period (N =1800) to determine the effects of early fluid resuscitation on mortality, early initiation of fluid administration was associated with a reduction in mortality for severe sepsis and septic shock patients (OR 0.63; 95% CI 0.46 to 0.86) (Leisman et al., 2016). After the initial resuscitation, reassessments are recommended to determine the need for additional fluid requirements (Makic & Bridges, 2018). The recommended reassessments include analyzing (a) heart rate, (b) blood pressure, (c) oxygen saturation, (d) respiratory rate, (e) temperature, and (f) urine output (Levy et al., 2018; Makic & Bridges, 2018; Rhodes et al., 2017).

If hypotension continues after initial fluid resuscitation, administration of vasopressors is necessary to maintain a MAP ≥ 65 mmHg (Gotts & Matthay, 2016; Rhodes et al., 2017). The first vasopressor recommended for treatment of continued hypotension associated with sepsis is norepinephrine, with the addition of vasopressin if

the target MAP is not met by norepinephrine alone (Rhodes et al., 2017). The administration of norepinephrine increases MAP through systemic vasoconstriction, with little changes in heart rate and stroke volume (Gotts & Matthay, 2016; Levy et al., 2018). If the presence of shock continues after starting vasopressor therapy, hemodynamic variables of the individual should be assessed, including the evaluation of cardiac function. (Makic & Bridges, 2018; Rhodes et al., 2017). In a systematic review and meta-analysis of randomized control trials conducted over a 4-month period from March 2014-June 2014 of 32 trials (n=3544) that compared norepinephrine to dopamine was associated with a decreased all-cause mortality (RR 0.89 [95% Cl 0.81-0.98). No advantage to norepinephrine over other vasopressors was reported on length of stay (median 15 days, range 7-52). Norepinephrine was associated with a lower risk of major events for major adverse events (RR 0.34 [95% Cl 0.14 0.84) (Avni et al., 2015).

Screening and Improvement Initiatives

Challenges exist in screening for sepsis, as there are no exact clinical criteria established for identifying this disorder (Seymour et al., 2016; Singer et al., 2016). Measures that assist with rapid recognition can aid in reducing unnecessary delays in treatment initiation (Seymour et al., 2016). Early identification of sepsis has been accomplished through implementing screening tools, such as early warning scores that provide list assessment parameters and laboratory values linked to presenting manifestations of this condition (Seymour et al., 2016; Singer et al., 2016; Torsvik et al., 2016). The SSC recommends that performance improvement programs aimed at earlier identification be implemented within hospitals through formal screening programs (Rhodes et al., 2017).

Despite the challenge of identifying at-risk patients, multiple early warning systems have been developed that incorporate measures commonly for the criteria of SIRS (Serafim, Gomes, Salluh, & Póvoa, 2018). These criteria assess irregularities in temperature, heart rate, respiratory rate, and white blood cell (WBC) count (Singer et al., 2016). In the Third International Consensus, experts from the gathered task force included recommendations for a new measure of screening at-risk patients, termed qSOFA for quick Sequential Organ Failure Assessment (Singer et al., 2016). This tool is not meant to be used as a sole measure for sepsis development, but rather a tool to assist clinicians in managing care. (Singer et al., 2016). This screening tool assesses altered mental status, systolic blood pressure of 100 mmHg or less, and respiratory rates of 22 or higher. The qSOFA has been reported to improve screening programs in multiple settings through incorporating a simple bedside criterion that does not involve evaluation of laboratory values (Singer et al., 2016).

In a systematic review and meta-analysis that included 23 studies (N = 147,000), positive qSOFA scores had a higher specificity than the routine screening tools for effectively detecting early in-patient mortality (0.83 vs. 0.29) (Song, Sin, Park, Shim, & Lee, 2018). When compared to the SIRS criteria, qSOFA was reported to be a limited predictive tool for adverse outcomes (Song et al., 2018). A meta-analysis, consisting of 10 studies (N = 229,480) conducted from February 2016 to June of 2017, compared qSOFA and SIRS for their sensitivity or specificity in diagnosing sepsis. This review concluded the SIRS was superior for diagnosing sepsis (RR, 1.32; 95% CI, 0.40-2.24; $P < .0001$), but the qSOFA was a better predictor of hospital mortality (RR, 0.03; 95% CI, 0.01-0.05; $P = .002$) (Serafim et al., 2018).

Transferring evidence-based measures into clinical practice can be a difficult process, as barriers in interdisciplinary members and departments may exist (Grek et al., 2017). Adherence to SSC guidelines varies with increased rates of compliance associated with hospitals who participate in performance improvement programs (Demiani et al., 2015; Levy et al., 2014). The SSC currently recommends that facilities participate in interdepartmental improvement programs for sepsis, as these have shown to improve patient outcomes (Jozwiak et al., 2016; Levy et al., 2014; Rhodes et al., 2017). In the multicenter study conducted by Levy et al., every reported 10% increase in sepsis performance bundle compliance and additional quarter of participation in the SSC performance improvement initiatives was associated with 0.7% reduction in sepsis mortality ($p < 0.001$) (2014). Successful implementation of performance programs includes sepsis guideline development and implementation, data collection, and targets guidelines for evaluation. Quality improvement initiatives are a valuable tool for promoting improvements in clinical practice and positive patient outcomes (Demiani et al., 2015; Rhodes et al., 2017).

Rationale

The evidence-based framework used to guide this project was the Donabedian model. This conceptual framework is a model developed by Adevis Donabedian that has been used for decades to advance and evaluate health services. This model outlines three approaches to evaluating health care that include structure, process, and outcome (Brosnan, 2012). This conceptual framework applies to the proposed project through assistance with the modification of structural components and implementation of processes to improve outcomes of one population at the system level.

Structure refers to the organizational support and the environment in which care is rendered. Structural components include hospital facilities, proficient personnel, equipment, and other operation factors (Brosnan, 2012). The structures of this project included: (a) adult units of a regional Level II Trauma Center and (b) the facilities Sepsis Advisory workgroup, administrative staff, physicians, and nurses.

Process refers to the interactions between practitioners and patients throughout the delivery of care, which should reflect current standards of clinical practice. Diagnostic testing, diagnosis of conditions, clinical results, prescribed treatment regiments, and types of patient education are all process characteristics (Brosnan, 2012). The process of this project included a best practice recommendation to assist with developing an evidence-based guideline for early adult sepsis treatment.

Outcomes are the result of implementing changes in the structures and processes, which includes the measurable change in the status of the patient as the result of the delivered healthcare. Outcome components validate the effectiveness and quality of the care rendered (Brosnan, 2012). The outcome of this project included increased knowledge of an expert panel after an in-service that has the potential to improve patient outcomes.

Specific Aims

The purpose of this DNP project was to determine the current best practice recommendations for early adult sepsis management to assist an existing quality improvement program with the implementation of an evidence-based adult sepsis guideline. Effective management of sepsis through the implementation of evidence-based clinical guidelines has shown to decrease hospital stays, improve patient outcomes,

increase financial savings, and, ultimately, lead to lower mortality rates (Damiani et al., 2015; Levy et al., 2014; Torsvik, 2016). Therefore, the goal of this project was to reveal relevant evidence for early adult sepsis management to assist a Level II Trauma Center in south Mississippi with improving adult patient outcomes and reducing the mortality of sepsis.

DNP Essentials

According to the American Association of Colleges of Nursing (AACN, 2006), the DNP Essentials outline eight central competencies for all advanced nursing practice roles. Through the completion of this doctoral project, all essentials were met and are expanded upon in Appendix F. The competencies highlighted in this doctoral project include Essentials I, II, and VIII.

Summary

Sepsis is a medical emergency that is similar to stokes and polytrauma, which necessitate prompt identification and treatment initiation. Screening initiatives for the early recognition of patients with sepsis or potential infections are essential to initiate appropriate treatment measures. The critical points for sepsis management by the SSC are outlined in the updated one-hour bundle published in 2018. Numerous studies have revealed that the implementation of interventions outlined by the SCC is associated with improved patient outcomes and reduced rates of sepsis mortality. Additionally, quality improvement initiatives are a valuable tool for promoting improvements in clinical practice and positive patient outcomes.

CHAPTER II – METHODS

Context

The facility where this doctoral project was conducted at is the chief hospital for a collaborative network of medical institutions that provides regional health services across 19 surrounding counties. During the time of this project, the 545-bed facility contained 400 general in-patient beds and 52 ED beds; which experienced approximately 2,800 in-patient admissions and 7,300 ED visits each month. According to the MDH (2018), 136 reported deaths were caused by septicemia within this region in 2017, 99% of which occurred in adults 25 years and older and 73% in those 65 years and older. Additionally, the local county of the facility experienced the second-highest occurrence of sepsis mortality within the region, which included 20 reported fatalities that year (MDH, 2018). The demographics of the local region during this best practice project were 68.3% Caucasian, 28.9% African American, 2.4% Hispanic, and 0.4% from other races (MDH, 2018).

Intervention, Study of the Intervention, and Measures

During the initial phase of the intervention, a comprehensive literature review was conducted to analyze the current evidence and best practice guidelines for early adult sepsis management. The gathered literature was then organized and recorded into a literature matrix, as shown in Appendix A, based on the year published and level of evidence. Among the literature reviewed, authors agreed that sepsis and septic shock are medical emergencies that are similar to stokes and polytrauma, which necessitate prompt identification and treatment initiation (Lester et al., 2018; Levy et al., 2018; Rhodes et al., 2017). The reviewed literature reported that the current best practice recommendations

for the early management of adult patients with sepsis include seven essential components. The first component includes measuring a serum lactate level within one hour of sepsis recognition and revaluating the serum lactate measurement if the initial level is ≥ 2 mmol/L. Additionally, the current best practice recommendations include obtaining blood cultures prior to the administration of antibiotic therapy and administering broad-spectrum antibiotics within one-hour sepsis recognition. The next components of these recommendations include the rapid administration of 30 mL/kg of IV crystalloid within one hour of sepsis recognition associated with hypotension or serum lactate ≥ 4 mmol/L; and administering vasopressors for hypotension during or after the initial fluid resuscitation to maintain a MAP ≥ 65 mmHg. The last component includes frequent reassessments of fluid status are recommended to be conducted through noninvasive measurements including, vital sign assessment; cardiopulmonary, capillary refill, pulse, and skin findings; and bedside cardiovascular ultrasound (Lester et al., 2018; Levy et al., 2018; Rhodes et al., 2017).

A report of findings was created, as shown in Appendix B, which compared components of the facilities ongoing quality improvement program to the current best practice recommendations gathered. The report of findings was then presented to a panel of experts for review and evaluation. The expert panel included: (a) two ACNPs, (b) two ED physicians, and (d) two CRNAs at the facility. The experts were selected for the panel due to their direct role in providing care to adult patients with sepsis, their extensive knowledge, and the ability to provide feedback on the current topic. The best practice recommendations and supporting evidence were presented to each participant of the expert panel in person.

Following the oral presentation, the members of the panel were presented with an evaluation tool, as shown in Appendix C, to obtain feedback on the information provided. The first question of the evaluation tool assessed whether the presented information regarding the current best practice guidelines for sepsis management was new to each participant. The second question assessed whether the information provided was beneficial. The third question assessed whether the provided information was relevant to the participants' institution. Lastly, the fourth question assessed whether the members of the expert panel would consider adopting the best practice recommendation provided. The participates were instructed not to include any identifying information on the completed evaluation tools to keep results confidential. Data was kept on a personal computer that required a password for entry and files were kept in a locked filing cabinet. After completion of this project, all input data was permanently destroyed from the personal computer, and all files were shredded.

Analysis

After presenting the best practice recommendations to the expert panel in person, qualitative data was collected through an evaluation tool, as shown in Appendix C. All six participants completed the provided questionnaires. Obtained responses were compiled, as shown in Table 5, to analyze feedback and concerns. The data gathered was analyzed qualitatively to assess whether the best practice recommendations provided were beneficial and relevant to the institution where this doctoral project was conducted.

Ethical Considerations

This project was conducted at a clinical affiliate hospital after approval from the University of Southern Mississippi (USM) Institutional Review Board (IRB) (Protocol

#19060705, Appendix D). An ethical consideration for this project involved whether or not the panel of experts would not consider adopting the best practice recommendation provided. Supporting evidence suggests that implementation of the best practice recommendations, which includes the one-hour bundle for sepsis management, has been correlated with improved patient outcomes and reduced rates of sepsis mortality. The methods used to formulate these best practice recommendations did not result in any direct patient contact.

Summary

The purpose of this DNP project was to determine the current best practice recommendations for early adult sepsis management to assist an existing quality improvement program with the implementation of an evidence-based adult sepsis guideline. The best practice recommendations gathered were presented to a panel of experts for review and evaluation. An evaluation tool was utilized to gather feedback from the participants of this panel.

CHAPTER III - RESULTS

Overview

The purpose of this DNP project was to determine the current best practice recommendations for early adult sepsis management to assist an existing quality improvement program with the implementation of an evidence-based adult sepsis guideline. The gathered best practice recommendations and supporting evidence was presented to an expert panel that included two ACNPs, two ED physicians, and two CRNAs employed at the facility where the project was conducted. The panel participants were selected due to their direct role in providing care to adult patients with sepsis, their extensive knowledge, and the ability to provide feedback on the current topic. Following the presentation, the participants were presented with an evaluation tool, as shown in Appendix C, to obtain feedback on the information provided. Four panel members strongly agreed that the presented information was beneficial and relevant to their institution, while the other two members agreed with these statements. Additionally, each panel member was willing to adopt the best practice recommendation at their facility. Out of the six participants, two answered no to the first question, which sought to determine whether the presented information regarding the updated 2018 bundle for sepsis management was new to each member. The results obtained via the evaluation tool reported that four members of the expert panel were unaware of the 2018 bundle update, which resulted in four members of the panel being provided with new information for the management of adult patients with sepsis based on the best practice recommendations presented.

Table 5

Panel of Experts Responses on the Presented Best Practice Recommendations

Evaluation Tool Questions	Panelist #1	Panelist #2	Panelist #3	Panelist #4	Panelist #5	Panelist #6
Is this presentation regarding the updated 2018 bundle for sepsis management new to you?	Yes	Yes	No	No	Yes	Yes
Was the information provided beneficial?	Strongly Agree	Strongly Agree	Agree	Agree	Strongly Agree	Strongly Agree
Was the information provided relevant to your institution?	Strongly Agree	Strongly Agree	Agree	Agree	Strongly Agree	Strongly Agree
Would you consider adopting these best practice recommendations?	Yes	Yes	Yes	Yes	Yes	Yes

Summary

Qualitative data found via the evaluation tool showed that 66.67% of the expert panel strongly agreed that the information provided was beneficial and relevant to their institution. Additionally, 66.67% of the panel were provided with new information for the management of adult patients with sepsis based on the best practice recommendation presented. Each member of the expert panel agreed the best practice recommendations should be adopted, with one member suggesting that “fluid administration amounts be

adjusted based on the individual patient's history." The panel participants provided no further feedback.

CHAPTER IV – DISCUSSION

Summary

Transforming healthcare systems to meet the demand for safe, quality, and affordable care is accomplished by incorporating new knowledge into clinical practice (White, 2016). Implementation of evidence-based practices guidelines through quality improvement initiatives are means of not only providing beneficial advances in patient care, but effective structural changes that result in improved organizational efficiency and lower costs of health care delivery (Baron, Metnitz, Rhodes, & Kozek-Langenecker, 2017). Additionally, evidence-based practices assist with reducing ineffective interventions that can produce adverse patient outcomes (Baron, 2017; Lowell, 2017). The purpose of this project was to determine the current best practice recommendations for early adult sepsis management to assist an existing quality improvement program with the implementation of an evidence-based adult sepsis guideline. The literature review conducted during the initial phase of this project indicated that improving the early identification and treatment of sepsis is essential to reducing the morbidity and mortality in this population (Rhodes et al., 2017; Singer et al., 2016). Prompt initiation of evidence-based interventions have shown to (a) decrease the length of hospital stays, (b) reduce ICU admissions, (c) improve overall patient outcomes, (d) increase financial savings, and (e) and ultimately lead to lower mortality rates within this population (Damiani et al., 2015; Levy et al., 2014; Torsvik et al., 2016). By synthesizing the current evidence and providing best practice recommendations, this doctoral project has the potential to improve the management of adult patients with sepsis and improve patient outcomes.

Interpretation

Best practice recommendations for the early management of adult patients with sepsis were individually presented to an expert panel in-person, which included two ACNPs, two ED physician, and two CRNAs. Throughout the completion of this project, multiple DNP Essentials were met, each of which are shown and expanded upon in Appendix F (AACN, 2006). Following the presentation, the panel of experts were given the opportunity to provide feedback via an evaluation tool, shown in Appendix C. Based on the feedback obtained, the panel participants were receptive to the recommendations provided.

Limitations

Limitations of this study included a small sample size of panel members selected to evaluate the purposed best practice recommendations. With the inclusion of only six participants, a larger panel of experts may have proved beneficial to the evaluation process of this project. Another limitation is the potential for a biased presentation due to the extensive research conducted prior to the presentation to the expert panel. Additionally, the implications of the findings were limited to the one site of this project located in south Mississippi.

Conclusion

Sepsis and septic shock are medical emergencies that are similar to stokes and polytrauma, which necessitate prompt identification and treatment initiation (Lester et al., 2018; Levy et al., 2018; Rhodes et al., 2017). In the ever-evolving world of health care, providers must be up to date with current evidence-based practice guidelines in order to reduce healthcare costs and improve patient outcomes (Baron et al., 2017; White,

2016). Incorporating current best practice recommendations published by the SSC have shown to (a) decrease the length of hospital stays, (b) reduce ICU admissions, (c) improve overall patient outcomes, (d) increase financial savings, and (e) ultimately lead to lower mortality rates within this population (Damiani et al., 2015; Levy et al., 2014). The current best practice recommendations for the early management of adult patients with sepsis include seven essential components. The first component includes measuring a serum lactate level within one hour of sepsis recognition and revaluating the serum lactate measurement if the initial level is ≥ 2 mmol/L. Additionally, the current best practice recommendations suggest obtaining blood cultures prior to the administration of antibiotic therapy and administering broad-spectrum antibiotics within one-hour sepsis recognition. The next components of these recommendations include the rapid administration of 30 mL/kg of IV crystalloid within one hour of sepsis recognition associated with hypotension or serum lactate ≥ 4 mmol/L; and administering vasopressors for hypotension during or after the initial fluid resuscitation to maintain a MAP ≥ 65 mmHg. The last component includes frequent reassessments of fluid status are recommended to be conducted through noninvasive measurements including, vital sign assessment; cardiopulmonary, capillary refill, pulse, and skin findings; and bedside cardiovascular ultrasound (Lester et al., 2018; Levy et al., 2018; Rhodes et al., 2017).

APPENDIX A -- Literature Matrix

Author/Year/ Title	Design/ Level	Sample/ Data Collection	Major Outcomes/ Measurements	Findings	Conclusions/ Recommendations
Avni et al., 2015 Vasopressors for the Treatment of Septic Shock: Systematic Review and Meta-Analysis	Systematic review and meta-analysis of randomized control trials (RCTs) Level I	32 trials (n = 3,544) included. Data extracted between 03/2014 and 06/2014 by two independent reviewers. Exclusion criteria: studies that assess different dosages or schedules of the same vasopressors.	Primary: • All-cause mortality at 28 days Secondary: • Length of ICU and/or hospital stays in live, discharged patients • Ventilator free days • Vasopressor free days • Hemodynamic profiles • Adverse events	• Compared to dopamine (n = 866, 450 events), norepinephrine (n = 832, 376 events) was associated with decreased all-cause mortality, RR 0.89 (95% Cl 0.81-0.98) • No advantage of norepinephrine to other vasopressors on LOS (median 15 days, range 7-52) • Norepinephrine was associated with lower risk for major adverse events, RR 0.34 (95% CI 0.14 0.84, I^2 = 0%, n = 3) and cardiac dysrhythmias, RR 0.48 (95% CI 0.40–0.58, I^2 = 30%, n = 4) compared to dopamine • No mortality benefit was demonstrated for the comparisons of norepinephrine and epinephrine, phenylephrine, or vasopressin	• Norepinephrine should be regarded as the first-line vasopressor in the treatment of septic shock • Improved benefits, better hemodynamic profile and reduced adverse reactions experienced with norepinephrine over dopamine • Trials to guide recommendations for other vasopressors are needed
Damiani et al., 2015 Effect of Performance Improvement Programs on Compliance with Sepsis Bundles and Mortality: A Systematic Review and Meta-Analysis of Observational Studies	Systematic review and meta-analysis of observational studies Level III	50 observational studies published between 2006 and 2014. Data extracted by two independent reviews.	Evaluate the impact of performance improvement programs on compliance with Surviving Sepsis Campaign (SSC) guideline-based bundles and/or mortality.	Performance improvement programs were associated with: • Increased compliance with the complete 6-hour bundle (OR = 4.12 [95% confidence interval 2.95-5.76]) and the complete 24-hour bundle (OR = 2.57 [1.74-3.77]) • Reduced mortality (OR = 0.66 [0.61-0.72])	• Performance improvement programs increase compliance with the SSC guideline-based bundle targets and are associated with decreased mortality in patients with sepsis, severe sepsis or septic shock
Gu, Zhang, & Bakker, 2015 Early lactate clearance-guided therapy in patients with sepsis: a meta-analysis with trial sequential	Meta-analysis of random controlled trials Level I	4 Random Controlled Trials (n=547).	Evaluation of early lactate clearance-guided therapy. Primary outcome: • All-cause mortality Secondary outcome:	• Early lactate clearance-guided therapy was associated with a reduction in mortality (RR -.65, 95 % Cl o.49-0.85, p = 0.002) • Early lactate clearance-guided	• Use of lactate clearance as a goal to guide early therapy is associated with a reduction in the risk of health in adult patients with sepsis

analysis of randomized controlled trials			• Length of hospital and ICU stay	therapy had no effect on length of hospital stay (weighted mean difference, WMD –0.13 days, 95 % CI –4.58 to 4.31, three RCTs [2, 3, 5]) and length of ICU stay (WMD)–1.54 days, 95 % CI –3.22 to 0.15, four RCTs [2–5]	• Further research is needed, as the underlying mechanisms by which lactate therapy benefit septic patients remains to be investigated
Johnston et al., 2017 Effect of Immediate Administration of Antibiotics in Patients with Sepsis in Tertiary Care: A Systematic Review and Meta-analysis	Systematic review and meta-analysis Level III	11 studies consisting of 1 randomized control trial, 6 retrospective cohort studies, 3 prospective cohort studies, and 1 pre-post observational study conducted between 2005-2013 (n=20,348). Data extracted by two independent authors.	Primary: In-hospital mortality of septic patients presenting to the emergency department with immediate (within 1 hour) antibiotic administration to later administration (> 1 hour).	• 10 studies reported in-hospital mortality between 4%-34% immediate administration and between 19%-43% mortality for later administration • The pooled results suggest a significant 33% reduction in mortality odds for immediate (within 1 hour) compared with later (>1 hour) antibiotic administration (OR, 0.67 [95% CI, 0.59– 0.75]) in patients with sepsis	• Early recognition of sepsis with immediate administration (< 1 hour) of antibiotics seems to reduce patient mortality
Jozwiak, Monnet, & Teboul, 2016 Implementing Sepsis Bundles	Expert opinion Level VII	N/A	Brief summary of the defining characteristics, benefits, limits, and pitfalls of sepsis bundles.	N/A	• Implementation of sepsis bundles results in decreased mortality and improved outcomes of patients with septic shock • Benefits of sepsis bundles depend on compliance and educational programs
Leisman et al., 2016 Association of Fluid Resuscitation Initiation Within 30 Minutes of Severe Sepsis and Septic Shock Recognition with Reduced Mortality and Length of Stay	Prospective observational cohort study Level III	Urban tertiary care center. Severe sepsis or septic shock patients recorded in a performance improvement database (n = 1,866) from 09/2013-09/2014.	Primary: • Determine the association of initiating intravenous fluid resuscitation within 30 minutes of severe sepsis or septic shock identification in the ED with in-hospital mortality Secondary: • To calibrate the 30-minute specification by assessing the	• Primary analysis: 64% (n = 1193) of subjects received intravenous fluid within 30 minutes • Mortality was lower in the 30-minute group (159 [13.3%] vs. 123 [18.3%]; 95% confidence interval [CI] 1.4% to 8.5%) • Median hospital length of stay was also reduced in the 30-minute group (6 days [95% CI 6 to 7] versus 7 days [95% CI 7 to 8])	• The initiation of intravenous fluid resuscitation is associated with improved mortality which could be used as a performance indicator in severe sepsis and septic shock management

			relationship between whether intravenous fluid resuscitation initiated within 30 minutes, 31 to 60 minutes, 61 to 180 minutes, or greater than 180 minutes and in-hospital mortality in an adjusted model	• IV fluid administration within 30 minutes was associated with lower mortality (odds ratio 0.63; 95% CI 0.46 to 0.86) and 12% shorter length of stay (95% CI 1.02 to 1.27) • Secondary Analysis: Mortality increased with later IV fluid resuscitation initiation: 13.3% (30 minutes) versus 16.0% (31 to 60 minutes) versus 16.9% (61 to 180 minutes) versus 19.7% (>180 minutes)	
Leisman et al., 2017 Survival Benefit and Cost Savings from Compliance with a Simplified 3-Hour Sepsis Bundle in a Series of Prospective, Multisite, Observational Cohorts: Critical Care Medicine	Prospective multisite observational study Level IV	Three independent cohorts, from a single U.S. health system. Cohort 1: five tertiary and six community hospitals in 2012 (n=5,819). Cohort 2: Single tertiary, academic medical center in 2014(n=1,697). Cohort 3: five tertiary and four community hospitals in 2015 (n=7,239).	Primary • In-hospital mortality • Total direct cost in cohorts 2 and 3	Cohort 1 • Bundle compliance: 1,050 (18%) • Mortality: 604 (22.6%) versus 834 (26.5%); Cl, 0.9-7.1%; adjusted odds ratio, 0.72; CI, o.61-0.86; p value is less than 0.001 Cohort 2 • Bundle compliance: 739 (43.5%) • Mortality: 99 (13.4%) versus 171 (17.8%); CI, 1.0-7.9%; adjusted odds ratio, 0.60; CI 0.44-0.80; p value is equal to 0.001 • Mean costs: $14,845 versus $20,056; CI, -$4,798 to -5,624; adjusted β, -$2,851; CI, -$4880 to -822; p value is equal to 0.006 Cohort 3 • Bundle compliance: 2,115 (29.2%) • Mortality: 383 (18.1%) versus 1,078 (21.0%); CI, 0.9–4.9%; adjusted odds ratio, 0.84; CI, 0.73–0.96; p value is equal to 0.013 • Mean costs: $17,885 versus $22,108; CI, –	• Bundle compliance from three independent cohorts was associated with reduced mortality and improved cost savings

				$2,783 to –5,663; adjusted β, –$1,423; CI, –$2,574 to –272; p value is equal to 0.015	
Levy et al., 2018 The Surviving Sepsis Campaign Bundle: 2018 update	Clinical Practice Guideline Level I	N/A	To provide an update to the 2016 Surviving Sepsis Campaign Guidelines for Management of Sepsis and Septic Shock. Use of grading recommendations assessment, development and evaluation system to guide assessment of quality evidence.	• Measure lactate level within one hour of sepsis recognition. Re-measure if initial lactate is > 2 mmol/L – Weak recommendation. Low quality of evidence • Obtain blood cultures prior to administration of antibiotics – Best practice statement • Administer broad-spectrum antibiotics within one hour of sepsis recognition – Strong recommendation, moderate quality of evidence • Rapidly administer 30 ml/kg crystalloid for hypotension or lactate ≥ 4 mmol/L within one hour of sepsis recognition – Strong recommendation, low quality of evidence • Apply vasopressors if patient is hypotensive during or after fluid resuscitation to maintain MAP ≥ 65 mmHg – Strong recommendation, moderate quality of evidence	• Sepsis is a medical emergency, similar to stroke and polytrauma, that necessitates prompt recognition and treatment initiation • Elements of the updated 2018 bundle should be implemented within one of sepsis recognition
Levy et al., 2014 Surviving Sepsis Campaign: association between performance metrics and outcomes in a 7.5-year study	Prospective observational cohort study Level IV	29,470 subjects entered into SSC database between 01/2005-06/2012 at 218 community, academic, and tertiary care hospitals in the United States. Compliance was defined as evidence that all bundle elements achieved.	Primary: • Associated mortality rates Secondary: • SSC bundle compliance • Length of hospital and ICU stay Compliance was defined as evidence that all bundle elements achieved.	• Overall lower mortality was observed in high (29.0 %) versus low (38.6 %) resuscitation bundle compliance sites ($p < 0.001$) and between high (33.4 %) and low (32.3 %) management bundle compliance sites ($p = 0.039$) • Hospital mortality rates dropped 0.7 % per site for every 3	• Increase compliance with sepsis performance bundles was associated with a 25% relative risk reduction in mortality • Performance metrics can improve quality of care, clinical behavior, and may reduce sepsis-related mortality

				months (quarter) of participation ($p < 0.001$) • Hospital and intensive care unit length of stay decreased 4 % (95 % CI 1–7 %; p = 0.012) for every 10 % increase in site compliance with the resuscitation bundle	
Novosad et al., 2016 Vital Signs: Epidemiology of Sepsis: Prevalence of Health Care Factors and Opportunities for Prevention	Retrospective chart review Level VI	Medical records of 246 adults and 79 children (aged birth to 17) at four New York Hospitals.	To describe the demographics, clinical characteristics, underlying chronic conditions, and infection types among patients with sepsis.	• 72% of patients had a health care factor during the 30 days before sepsis admission or a chronic co-morbidity that required frequent medical care • 25% (n=82) died, 26% of these deaths (n=65) were 65 or older and 22% were infants and children (n=27) • Most common pathogen in blood cultures of adults ≥ 18 years– Escherichia coli; of children ≥ 1 year – Klebsiella spp.; of infants < 1 year – Enterococcus • Most common illness that leads to sepsis – pneumonia 35% (n=85) • Patients with sepsis experience severe illness and poor outcomes including longer: hospital stays (median=10days), discharge to long-term settings (20%) and mortality (25%)	Five key sepsis prevention strategies include: 1. Increasing sepsis awareness among the public and professional communities 2. Promoting early recognition of sepsis and administering antibiotics as soon as possible 3. Identifying at-risk populations 4. Developing better sepsis surveillance methods 5. Preventing infections that lead to sepsis
Rhodes et al., 2017 Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016	Clinical practice guideline Consensus committee of 55 international experts representing 25 international organizations. Level I	N/A	To provide an update to the 2012 Surviving Sepsis Campaign Guidelines for Management of Sepsis and Septic Shock. Use of Grading Recommendations Assessment, Development and Evaluation system to guide	The Surviving Sepsis Guideline panel provided 93 states on early management and resuscitation of patients with sepsis or septic shock including: • 32 strong recommendations • 39 weak recommendations • 18 best practice statements • Four questions were left unaddressed	Sepsis and septic shock are medical emergencies for which treatment and resuscitation should begin immediately Hospitals and hospital systems are recommended to have a performance improvement program for sepsis, including sepsis screening for acutely ill, high-risk patients

			assessment of quality evidence.		
Serafim, Gomes, Salluh, & Póvoa, 2018 A Comparison of the Quick-SOFA and Systemic Inflammatory Response Syndrome Criteria for the Diagnosis of Sepsis and Prediction of Mortality	Systematic review and meta-analysis of observation studies Level III	10 prospective observational studies (n=229, 480). Data extracted by two independent authors from 02/2016-7/2017. Exclusion criteria: data described about specific populations and case studies.	Comparing the sensitivity and specificity in diagnosing sepsis, hospital length of stay, and mortality of qSOFA and SIRS in patients outside the ICU.	• Sensitivity for the diagnosis of sepsis was in favor of SIRS (risk ratio [RR], 1.32; 95 % Cl, 0.40-2.24; p < 0.0001) • Comparing the qSOFA and SIRS score, the qSOFA is a better predictor of in-hospital mortality (risk ratio [RR], 0.03 95 % Cl, 0.02-0.05k; P=0.002) • One-year mortality for patients who met qSOFA criteria was higher that of SIRS criteria (RR, 29.4; 95 % Cl, 22.3-38.7 vs 14.7; 95 % Cl, 12.5-17.2)	• The SIRS is significantly superior for sepsis diagnosis • The qSOFA is better at predicting hospital mortality than the SIRS • Quality improvement initiatives should include both criteria, which could improve early sepsis recognition and reduce the development of septic shock
Seymour et al., 2016 Assessment of Clinical Criteria for Sepsis: For the Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3)	Retrospective cohort study Level IV	Primary cohort: All hospital encounters of adult patients (age ≥ 18 years) with sepsis infection at 12 community and academic hospitals in southwestern Pennsylvania from 2010-2012 (n=148,907). Primary cohort randomly split (50/50) for derivation (n=74,453) and validation cohort (74=454). Confirmatory analysis: Out-of-hospital encounters and hospital encounters at 165 U.S and non-U.S. hospitals from 01/2008-2013 extracted from 4 data sets.	To evaluate the validity of clinical criteria to identify patients with suspected infection who are at risk for sepsis: • Systemic Inflammatory Response Syndrome (SIRS) • Sequential Organ Failure Assessment (SOFA) • Quick Sequential Organ Failure Assessment (qSOFA) • Logistic Organ Dysfunction System (LODS) score Primary: • In-hospital mortality • Secondary: • ICU length of stay ≥ 3 days	• Primary cohort - 6347 (4%) deaths • Validation cohort ICU (n = 7932 with suspected infection) 1289 (16%) deaths • Predictive validity for in-hospital mortality was lower for SIRS (AUROC = 0.64; 95% CI, 0.62–0.66) and qSOFA (AUROC = 0.66; 95% CI, 0.64–0.68) vs SOFA (AUROC = 0.74; 95% CI, 0.73–0.76; P <. 001 for both) and LODS (AUROC = 0.75; 95% CI, 0.73–0.76; P < .001 for both) • Validation cohort non-ICU (n = 66 522 with suspected infection) 1886 (3%) deaths • qSOFA had predictive validity (AUROC = 0.81; 95% CI, 0.80–0.82) that was greater than SOFA (AUROC = 0.79; 95% CI, 0.78–0.80; P < .001) and SIRS (AUROC = 0.76; 95% CI, 0.75–0.77; P < .001)	• In the ICU, the predictive validity for in-hospital mortality of SOFA was statistically greater than SIRS and qSOFA, supporting its use in clinical criteria for sepsis • Outside of the ICU, the predictive validity for in-hospital mortality of qSOFA was statistically greater than SOFA and SIRS, supporting its use as a prompt to consider possible sepsis

				• Relative to qSOFA scores lower than 2, encounters with qSOFA scores of 2 or higher had a 3- to 14-fold increase in hospital mortality across baseline risk deciles. Findings were similar in external data sets and for the secondary outcome	
Singer et al., 2016 The Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3)	Expert opinion, review of literature Level VII	N/A	To evaluate and update definitions for sepsis and septic shock.	Limitations of previous definitions included: • Excessive focus of inflammation • Mislead model of sepsis as a continuum to severe sepsis to shock • Inadequate specificity and sensitivity of the SIRS criteria Multiple definitions and terminologies lead to discrepancies in reporting incidence and mortality.	• Sepsis should be defined as life-threatening organ dysfunction by a dysregulated host response to infection • Organ dysfunction can be represented by an increase in the Sequential [Sepsis-related] Organ Failure Assessment (SOFA) score of 2 points or more, which is associated with an in-hospital mortality greater than 10% • Septic shock should be defined as a subset of sepsis in which particularly profound circulatory, cellular, and metabolic abnormalities are associated with a greater risk of mortality than with sepsis alone • Septic shock can be clinically identified by a vasopressor requirement to maintain a mean arterial pressure of 65 mmHg or greater and serum lactate level greater than 2 mmol/L (>18 mg/dL) in the absence of hypovolemia
Teles et al., 2017	Observational retrospective study	167 patients were retrospectively	To assess the impact of a sepsis protocol on the	• Overall mortality: 31.1%	The use of a sepsis protocol was associated with

Impact of a sepsis bundle inwards of a tertiary hospital. Journal of Intensive Care	Level III	studied at Sana Casa de Misericordia de Maceió Hospital Data collection from 01/2012-12/2013.	outcomes of patients inwards of a tertiary hospital. 3-hour bundle consisted of: • Collecting lactate and cultures • Start broad-spectrum antibiotics in the first hour of sepsis diagnosis • Volume replacement with crystalloid if hypotension presents of lactate ≥ 2 mmol/L	• Individuals who received the 3-hour bundle showed a 44% lower mortality in comparison with who did not (25.6 vs. 45.7%; p = 0.01) and shorter length of stay in ICU (9.0 ± 5.90 versus 4.6 ± 6.20 days; p < 0.0001) • Greater frequency of ICU admissions in patients who did not receive the bundle (28.3 versus 15.8%; p = 0.06) • Sepsis bundle was independently correlated with lower mortality (OR = 0.175; CI = 0.04–0.64; p = 0.009)	lower mortality, reduced ICU admission, and shorter ICU stays
Torsvik et al., 2016 Early identification of sepsis in hospital inpatients by ward nurses increases 30-day survival	Before-and-after intervention study Level IV	Emergency room of a 124-bed community hospital in Norway. Patients with confirmed bloodstream infections (BSI). Pre-intervention group: 01/2008-12/2010 (n=422). Post-intervention group: 10/2011-12/201 (n=409).	To investigate whether implementation of a clinical tool for triage of SIRS and organ failure, an alert, and treatment flow chart could improve clinical observations, lead to fewer patients developing severe sepsis, and thus improve in-hospital.	The post-intervention group had higher odds of surviving 30 days (OR 2.7, 95 % CI 1.6, 4.6), lower probability of developing severe organ failure (0.7, 95 % CI 0.4, 0.9), and on average, 3.7 days (95 % CI 1.5, 5.9 days) shorter LOS than the pre-intervention group.	Early sepsis recognition by ward nurses may reduce progression and improve survival of patients with sepsis.

APPENDIX B – Report of Findings

2012 Surviving Sepsis Campaign Guidelines	2018 Surviving Sepsis Campaign Guidelines
Three Hour Bundle	**One Hour Bundle**
1. Measure lactate level 2. Obtain blood cultures prior to administration of antibiotics 3. Administer broad-spectrum antibiotics 4. Administer 30 mL/kg of IV crystalloid for hypotension or lactate ≥ 4 mmol/L	1. Measure lactate level. 2. Obtain blood cultures prior to administration of antibiotics. 3. Administer broad-spectrum antibiotics. 4. Begin rapid administration of 30 mL/kg of crystalloid for hypotension or lactate ≥ to 4 mmol/L.
Six Hour Bundle	
5. Apply vasopressors to maintain a MAP ≥ 65 mmHg. 6. Reassessment of volume status and tissue perfusion with documentation of findings if hypotension persists after initial fluid volume replacement or the initial lactate was ≥ 4 mmol/L. 7. Re-measure of lactate if initial lactate was elevated	5. Apply vasopressors if patient is hypotensive during or after fluid resuscitation to maintain MAP ≥ 65 mmHg. 6. Frequent hemodynamic reassessments of patient's fluid status through noninvasive measurements including vital sign assessment; cardiopulmonary, capillary refill, pulse, and skin findings; or bedside cardiovascular ultrasound; 7. Re-measure of lactate if initial lactate was elevated

Summary of Evidence

Sepsis and septic shock are medical emergencies that are similar to stokes and polytrauma, which necessitate prompt identification and treatment initiation (Lester et al., 2018; Levy et al., 2018; Rhodes et al., 2017). In 2018, the SSC updated the three-hour and six-hour bundles to incorporate new evidence, which now includes one bundle to be initiated within one-hour of sepsis recognition (Lester et al., 2018; Levy et al., 2018). In a recent study conducted over five years (N =1,060) that evaluated lactate levels as a predictor of mortality, higher levels of serum lactate were recorded from subjects who did

not survive (Ryoo et al., 2018). A systematic review and meta-analysis consisting of 10 quantitative studies published between 1990 and 2016 were conducted to determine the effect of antimicrobial administration on sepsis patients in tertiary care. This review reported a 33% reduction in mortality odds for patients who received IV antibiotics within one hour of sepsis recognition compared to the population who experienced detailed administration (OR, 0.67 [95% CI, 0.59-0.75]) (Johnston et al., 2017). Additionally, in a retrospective cohort study completed at a 656-bed medical institution (N =3,929) to determine the effects of initial antimicrobial administration with the progression of septic shock, each hour that antimicrobial administration was delayed associated with an 8% increase in progression of septic shock (Whiles, Deis, & Simpson, 2017). In an observational cohort study conducted over a 13-month period (N =1800) to determine the effects of early fluid resuscitation on mortality, early initiation of fluid administration was associated with a reduction in mortality for severe sepsis and septic shock patients (OR 0.63; 95% CI 0.46 to 0.86) (Leisman et al., 2016).

APPENDIX C – Evaluation Tool

Sepsis Quality Improvement Evaluation Tool
The University of Southern Mississippi

Participation in this questionnaire is voluntary. There are no repercussions for non-participation, and you may elect to discontinue completion at any time. Thank you for your time and help.

Do you consent to participate in this study? **YES** **NO**

Please rate the following questions by circling your answer.

1. Is this presentation regarding the 2018 guidelines for sepsis management new to you?

YES **NO**

2. Was the information provided beneficial?

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

3. Is the information provided relevant to your institution?

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

4. Would you consider adopting this best practice?

YES **NO**

5. Comment/concerns:

_____
_____
_____
_____
_____
_____

Thank you for your time and consideration.

Austin Williams, SRNA

APPENDIX D – IRB Approval Letter

ORI | Office of Research Integrity

THE UNIVERSITY OF SOUTHERN MISSISSIPPI

118 COLLEGE DRIVE #5116 • HATTIESBURG, MS | 601.266.6756 | WWW.USM.EDU/ORI

June 8, 2018

To Whom It May Concern,

I have reviewed the IRB Application of Austin Williams ("Implementation of an Evidence-Based Adult Sepsis Guideline") and have determined that IRB review and approval of this project is not required, given the nature of the data to be used.

If you have question about this, please contact me.

Sincerely,

Sam Bruton, Director

Samuel.Bruton@usm.edu

APPENDIX E – Letter of Support

FW: DNP Project - Sepsis

[redacted]

Hello!
I have determined that I can bring Austin on as an unpaid intern to complete his DNP project. As soon as we have a preceptor agreement in place, Austin can begin working with me. The internship approach has a couple of important benefits:

1. He will not need to present the project to the Nursing Research Committee because he will be working with me on my project and not as an independent professional using the facility as host for research or practice change.
2. He will have access to the data in the EHR that he requires for the project (under my mentorship).
3. FGH Education as well as Ms. Shaheed, the VP/CNO have approved this approach.

Part of the preceptor agreement is the establishment of specific goals that must be completed as part of the internship.

Austin, if at all possible, I would like you to attend a demo of our predictive analysis functionality and sepsis risk score this Friday, January 12, 2018 from 1-2 pm

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APPENDIX F – DNP Essentials

Doctor of Nursing Essentials		How the Essential is Achieved
I.	Scientific Underpinning for Practice	A review of current literature for the best practice of early adult sepsis management was performed. The information gathered was utilized to provide best practice recommendations for this DNP project.
II.	Organizational and Systems Leadership for Quality Improvement and System Thinking	This doctoral project sought to improve quality through determining best practice recommendations for early adult sepsis management that was presented to a panel of experts that would review the recommendations and disseminate the information provided.
III.	Clinical Scholarship and Analytical Methods for Evidence-Based Practice	This essential was met by performing an extensive literature review on the current evidence-based practice for early sepsis management in the adult population.
IV.	Health Care Policy for Advocacy in Health Care	This project leads to the potential improvement of a clinical practice guideline for management of adult patients with sepsis.
V.	Health Care Policy for Advocacy in Health Care	This essential was met by determining current best practice recommendations for early adult sepsis management that could be utilized for implementation of a new institutional policy.
VI.	Interprofessional Collaboration for Improving Patient and Population Health Outcomes	This project utilized effective communication between and members of an expert panel. Through completing this project, the dissemination of current evidence was accomplished that could be used for practice improvements.
VII.	Clinical Prevention and Population Health for Improving the Nation's Health	This essential was met by increasing awareness of potential measures to improve care provided to adult patients with sepsis.
VIII.	Advanced Nursing Practice	The best practice project was ultimately aimed at utilizing best practice recommendations to develop to improve an existing clinical practice guideline.

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